CLAIMS

1. An assembly for monitoring ionising radiation, comprising:

a detector substrate for generating electronic charge responsive to incident ionising radiation, said detector substrate configured to form an array of ionising radiation sense volumes; and

a circuit substrate supporting an array of read-out circuits corresponding to said array of sense volumes: wherein

each of said read-out circuits is switchable between first and second charge integration modes for receiving charge from a corresponding sense volume, and includes a charge integration circuit configured in said first charge integration mode to integrate charge corresponding to sensing of a single ionising radiation detection event in a corresponding sense volume and configured in said second charge integrating mode to integrate charge corresponding to sensing a plurality of ionising radiation detection events in said corresponding sense volume.

2. An assembly according to Claim 1, wherein each of said read-out circuits comprises first and second capacitances, each of said read-out circuits switchable between said first and second modes for accumulating charge in first and second capacitances respectively.

3. An assembly according to Claim 2, wherein said first capacitance is configured to be sufficient to provide a statistical likelihood of accumulating charge corresponding to a single detection event in said corresponding sense volume.

4. An assembly according to Claim 3, wherein said second capacitance is configured to be sufficient to provide a statistical likelihood of accumulating charge corresponding to a plurality of detection events in said corresponding sense volume.

5. An assembly of any one of Claims 2 to 4, wherein said capacitance in said second mode comprises a first capacitor and second capacitor, said assembly operative to accumulate charge on said first capacitor alone and to switchably couple said second capacitor to said first capacitor for providing a greater capacitance near to saturation of said first capacitor.

6. An assembly according to any preceding claim, wherein said read-out circuits comprise means for switching between said first and second modes.

7. An assembly according to any preceding claim, wherein said read-out circuits comprise circuitry for reading out charge accumulated in respective first and second capacitances.

8. An assembly according to any preceding claim, wherein said circuits comprise reset circuitry for discharging said capacitances subsequent to read-out of charge thereon.

9. An assembly for monitoring radiation, comprising:

a detector substrate for generating electronic charge responsive to incident radiation, said detector substrate configured to form an array of ionising radiation sense volumes; and

a circuit substrate supporting an array of read-out circuits corresponding to said sense volumes; wherein

a first of said read-out circuits includes photon counting circuitry responsive to a current pulse corresponding to the detection in said detector substrate of ionising radiation in a first energy range to increment a first count value, and a second of said read-out circuits including photon counting circuitry responsive to a current pulse corresponding to the detection in said detector substrate of ionising radiation in a second energy range to increment a second count value.

10. An assembly for monitoring radiation, comprising:

a detector substrate for generating electronic charge responsive to incident radiation, said detector substrate configured to form an array of ionising radiation sense volumes; and

a circuit substrate supporting an array of read-out circuits corresponding to said sense volumes; wherein

said read-out circuits comprise photon counting circuitry electronically configurable to respond to a current pulse corresponding to the detection in said detector substrate of ionising radiation in a first energy range to increment a first count value or to respond to a current pulse corresponding to the detection in said detector substrate of ionising radiation in a second energy range to increment a second count value.

11. An assembly according to Claim 10, wherein said photon counting circuitry is operative for a first detection period to be electronically configured to

respond to a current pulse corresponding to said first energy range, and operative in a second detection period to be electronically configured to respond to a current pulse corresponding to said second energy range.

12. An assembly according to Claim 11, wherein said first and second detection periods correspond to first and second frame read-out cycles of said array of read-out circuits.

13. An assembly according to any one of Claims 9 to 12, wherein said photon counting circuitry comprises threshold circuitry including lower and upper current threshold levels for defining one or other of said first and second energy range, said threshold circuitry configured to output a count pulse to a counter responsive to a current pulse having an amplitude within the range defined by said upper and lower threshold levels.

14. An assembly according to Claim 13, wherein said current threshold levels are electronically programmable.

15. An assembly according to any preceding claim, wherein said detector substrate comprises a semi-conductor material.

16. An assembly according to any preceding claim, further comprising conductive material disposed over a first surface of said detector substrate, and an array of conductive pads formed over a second surface of said detector substrate opposing said first surface for forming said array of said sense volumes, and wherein each of said array of conductive pads is electrically coupled to

corresponding ones of said array of charge storage circuits of said circuit substrate.

17. An assembly according to Claim 16, configurable in use to apply a bias signal between said conductive material and said conductive pads.

18. An assembly according to Claim 16 or 17, wherein said semi-conductor material comprises one of cadmium telluride (C_dT_e), cadmium zinc telluride ($C_dZ_nT_e$), silicon (S_i), amorphous silicon or Gallium Arsenide (G_aA_s).

19. An assembly according to any preceding claim, wherein said circuit substrate comprises semi-conductor material.

20. An assembly according to Claim 19, wherein said circuit substrate supports CMOS circuitry.

21. An assembly according to any preceding claim, wherein said sense volumes comprise a cross-section area in the range between 20μm x 20μm x 0.25mm to 2mm x 2mm x 5mm.

22. An assembly according to Claim 21, dependent on Claim 16, wherein the cross-sectional surface area of each of said conductive pads is in the range 15μx15μm to 1.95mm x 1.95mm

23. An ionising radiation dosimitor, comprising a semi-conductor detector substrate crystal configured with a plurality of ionising radiation sense

volumes, said detector substrate crystal supporting conductive material across a first surface thereof and an array of conductive pads disposed across a second surface thereof opposing said first surface thereby defining said plurality of sense volumes.

24. An ionising radiation dosimitor, comprising an assembly according to any one of Claims 1 to 22.

25. A circuit substrate for a dosimitor according to Claim 23 or 24, configured to receive charge from said ionising radiation detector substrate, said circuit substrate comprising an array of read-out circuits each of said read-out circuits switchable between first and second charge accumulation modes, said first charge accumulation mode operable to accumulate charge corresponding to a single detection event and said second charge accumulation mode operable to accumulate charge corresponding to a plurality of detection events.

26. A circuit substrate for a dosimitor according to Claim 23 or 24, configured to receive charge from said ionising radiation detector substrate, said circuit substrate comprising an array of read-out circuits including photon counting circuitry electronically configurable to respond to a current pulse corresponding to the detection in a detector substrate of ionising radiation in a first energy range to increment a first count value or to respond to a current pulse corresponding to the detection in a detector substrate of ionising radiation in a second energy range to increment a second count value.

27. A method for operating an assembly according to any one of Claims 1 to 7, the method comprising:

a) integrating charge corresponding to sensing of a single ionising radiation event; and

b) non-coincidental with step a) integrating charge corresponding to sensing of multiple ionising radiation events.

28. A method according to Claim 27, wherein step a) includes accumulating charge in a first capacitance suitable for accumulating charge corresponding to said single detection event, and wherein step b) includes accumulating charge in a second capacitance suitable for accumulating charge corresponding to said multiple detection events.

29. A method according to Claim 28, wherein said second capacitance comprises first and second capacitors, said first capacitor disposed between said second capacitor and detector substrate and said second capacitor between said first capacitor and read-out line, the method comprising accumulating charge in said first capacitor, switching said second capacitor into electrical connection with first said capacitor near to saturation of said first capacitor for accumulating full charge.

30. A method of reading accumulated charge from an assembly operating in accordance with any one of Claims 27 to 29, said method comprising interleaving reading charge corresponding to a single ionising detection event with reading charge corresponding to multiple detection of events.

31. A method for operating an assembly according to any one of Claims 9 to 11, the method comprising:

configuring photon-counting circuitry to respond to the current pulse corresponding to the detection of ionising radiation in a first energy range to increment a first count value;

reading a first count value from each of said photon-counting circuitry configured for said first energy range;

configuring said photon-counting circuitry to respond to a current pulse corresponding to detection of ionising radiation in said second energy range to increment a second count value; and

reading said second count value from said photon-counting circuitry.

32. An assembly for monitoring ionising radiation substantially as hereinbefore described with reference to Figures 1–4 and Figures 1,2, 6 and 7 respectively of the drawings.

33. A method of operating an assembly for monitoring ionising radiation substantially as hereinbefore described with reference to Figures 1–4 and Figures 1,2, 6 and 7 respectively of the accompanying drawings.

34. An ionising radiation monitoring network, comprising:

at least one ionising radiation monitoring device including a communications unit for communicating at least radiation data corresponding to radiation sensed by said device over a communications network; and

a control station configured to receive said radiation data from said device.

35. An ionising radiation monitoring network according to Claim 34, wherein said at least one device is configured to provide radiation data including spectroscopic data representative of the energy of said sensed radiation, and to transmit said spectroscopic data to said control station.

36. An ionising radiation monitoring network according to preceding Claims 34 or 35, wherein said at least one ionising radiation monitoring device includes a bi-directional communications unit for receiving at least voice data from said control station.

37. An ionising radiation monitoring network according to preceding Claims 34 to 36, said device further comprising position sensing circuitry operable to transmit position data to said control station, and wherein said control station is configured to associate said device, radiation data and positional data together for presentation to a user of said control station.

38. An ionising radiation monitoring network according to Claim 37, wherein said positional circuitry comprises circuitry for receiving positional data from a satellite global positioning system or other wireless positional information provider..

39. An ionising radiation monitoring network according to Claim 37 or 38, wherein said device periodically communicates said position data and radiation data to said control station.

40. An ionising radiation monitoring network according to any one of Claims 34 to 39, wherein said device is a portable device.

41. An ionising radiation monitoring network according to any one of preceding Claims 34 to 40, wherein said device comprises a wireless communications unit.

42. An ionising radiation monitoring network according to any one of preceding Claims 34 to 41, further comprising a plurality of ionising radiation monitoring devices.

43. An ionising radiation monitoring network according to Claim 37 or 38, or any of Claims 39 to 42 dependent upon Claim 4 or 5, wherein said control station is configured to plot at least radiation data and position received from one or more said devices.

44. An ionising radiation monitoring network according to Claim 42, wherein said control station is configured to provide a geographic display of said radiation and positional data to a user of said control station on a map representative of said network area.

45. An ionising radiation monitoring network according to any one of Claims 41 to 43, wherein said control station plots an identity of a device associated with each position radiation data.

46. A method of remote monitoring for ionising radiation, said method comprising:

receiving spectroscopic data representative of the energy of sensed radiation from a remote ionising radiation sensor over a communications network;

automatically determining from said spectroscopic data if said radiation is hazardous and issuing a warning signal if said radiation is hazardous.

47. A method according to Claim 46 further comprising transmitting a warning to said ionising radiation sensor for alerting a user of said sensor to the presence of hazardous radiation.

48. A method according to Claim 47, further comprising issuing voice commands to a user of said radiation sensor.

49. A method according to Claim 47, further comprising responding to voice commands to a user of said radiation sensor.

50. A method according to any one of Claims 46 to 48, further comprising monitoring the position of said ionising radiation sensor, and displaying said position and data indicative of said sensed radiation corresponding

to said position for providing "plume" analysis of a radiation contaminated environment.

51. An ionising radiation monitoring network substantially as hereinbefore described with reference to Figures 11 to 13 of the drawings.

52. A method of monitoring for ionising radiation substantially as hereinbefore described with reference to figures 11 to 13 of the drawings.